

## PATENT COOPERATION TREATY

## PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference <b>H0498.70281</b>	<b>FOR FURTHER ACTION</b> see Form PCT/ISA/220 as well as, where applicable, Item 5 below.	
International application No. <b>PCT/US2007/019669</b>	International filing date (day/month/year) <b>11/09/2007</b>	(Earliest) Priority Date (day/month/year) <b>11/09/2006</b>
Applicant  <b>PRESIDENT AND FELLOWS OF HARVARD COLLEGE</b>		

This International search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 8 sheets.

☐ It is also accompanied by a copy of each prior art document cited in this report.

**1. Basis of the report**

a. With regard to the language, the international search was carried out on the basis of:

- ☒ the international application in the language in which it was filed  
☐ a translation of the international application into \_\_\_\_\_, which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b))

b. ☐ This international search report has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43.6bis(a)).

c. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.

2. ☐ **Certain claims were found unsearchable** (See Box No. II)

3. ☐ **Unity of invention is lacking** (see Box No. III)

4. With regard to the title,

- ☒ the text is approved as submitted by the applicant  
☐ the text has been established by this Authority to read as follows:

5. With regard to the abstract,

- ☐ the text is approved as submitted by the applicant  
☒ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority

6. With regard to the drawings,

- a. the figure of the drawings to be published with the abstract is Figure No. 1a  
☒ as suggested by the applicant  
☐ as selected by this Authority, because the applicant failed to suggest a figure  
☐ as selected by this Authority, because this figure better characterizes the invention
- b. ☐ none of the figures is to be published with the abstract

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2007/019669

## Box No. IV Text of the abstract (Continuation of Item 5 of the first sheet)

The present invention generally relates to nanotechnology and, in particular, to branched nanoscale wires. In some cases, the branched nanoscale wires may be produced using vapor-phase and/or solution-phase synthesis. Branched nanoscale wires may be grown by depositing nanoparticles onto a nanoscale wire, and segments or "branches" can then be grown from the nanoparticles. The nanoscale wire may be any nanoscale wire, for example, a semiconductor nanoscale wire, a nanoscale wire having a core and a shell. The segments may be of the same, or of different materials, than the nanoscale wire, for example, semiconductor/metal, semiconductor/semiconductor. The junction between the segment and the nanoscale wire, in some cases, is epitaxial. In one embodiment, the nanoparticles are adsorbed onto the nanoscale wire by immobilizing a positively-charged entity, such as polylysine, to the nanoscale wire, and exposing it to the nanoparticles. In another embodiment, nanoparticles are deposited onto a nanoscale wire by etching the nanoscale wire to produce an H-terminated surface, then exposing the surface to a solution comprising a metal ion, which can be reduced by the surface to form nanoparticles. Segments or branches can then be grown from the deposited nanoparticles to form the branched nanoscale wire.

# INTERNATIONAL SEARCH REPORT

International application No  
PCT/US2007/019669

<b>A. CLASSIFICATION OF SUBJECT MATTER</b> INV. H01L21/20		
According to International Patent Classification (IPC) or to both national classification and IPC		
<b>B. FIELDS SEARCHED</b>		
Minimum documentation searched (classification system followed by classification symbols) H01L		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practical, search terms used) EPO-Internal, INSPEC		
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DELI WANG ET AL: "Rational growth of branched and hyperbranched nanowire structures" NANO LETTERS, ACS, WASHINGTON, DC, US, vol. 4, no. 5, May 2004 (2004-05), pages 871-874, XP009094914 ISSN: 1530-6984 cited in the application the whole document <div style="text-align: center; margin-top: 20px;">----- -/--</div>	1-13
<div style="display: flex; justify-content: space-between;"> <span><input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C.</span> <span><input checked="" type="checkbox"/> See patent family annex.</span> </div>		
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>* Special categories of cited documents:</p> <p>*A* document defining the general state of the art which is not considered to be of particular relevance</p> <p>*E* earlier document but published on or after the international filing date</p> <p>*L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>*O* document referring to an oral disclosure, use, exhibition or other means</p> <p>*P* document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 45%;"> <p>*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>*X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>*Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>*Z* document member of the same patent family</p> </div> </div>		
Date of the actual completion of the international search <div style="text-align: center; font-weight: bold;">24 January 2008</div>		Date of mailing of the international search report <div style="text-align: center; font-weight: bold;">09/04/2008</div>
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016		Authorized officer <div style="text-align: center; font-weight: bold; margin-top: 10px;">Wolff, Gerhard</div>

## INTERNATIONAL SEARCH REPORT

International application No

PCT/US2007/019669

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	YU ET AL: "One-dimensional silicon nanostructures fabricated by thermal evaporation" MATERIALS SCIENCE AND ENGINEERING C, ELSEVIER SCIENCE S.A, CH, vol. 26, no. 5-7, July 2006 (2006-07), pages 800-804, XP005461070 ISSN: 0928-4931 the whole document	1-13
A	US 2004/095658 A1 (BURETEA MIHAI [US] ET AL BURETEA MIHAI [US] ET AL) 20 May 2004 (2004-05-20) paragraphs [0024] - [0028], [0079] - [0084], [0148], [0149], [0211], [0212]	1-13

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US2007/019669

## Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers allsearchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-13

### Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

## FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

## 1. claims: 1-13

A method of producing a branched nanoscale wire characterised by etching the wire to produce an H-terminated surface and exposing this surface to a solution comprising a metal ion to form a nanoparticle from which the branch is grown.

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## 2. claims: 14-24

A method of producing a branched nanoscale wire (and corresponding article) wherein the wire has a core and a shell by immobilising a positively-charged entity to the shell and exposing it to a negatively-charged nanoparticle which is adsorbed thereby. The branch is grown from the nanoparticle.

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## 3. claims: 25-31

A method of producing a branched nanoscale wire characterised by depositing a nanoparticle on the wire and growing a metal segment therefrom.

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## 4. claims: 32-39

An article having a branched nanoscale wire having two segments which are of different composition.

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## 5. claims: 40-46

A method of producing a branched nanoscale wire characterised by depositing a nanoparticle on the wire, exposing it to a solution containing an ion, causing the ion to deposit on the nanoparticle, thereby causing growth of a segment.

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## 6. claims: 47-54

An article having a branched nanoscale wire of which at least one branch comprises a core and a shell, the core and the shell having different compositions.

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## 7. claim: 55

An article having a branched nanoscale wire able to emit light.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2007/019669

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2004095658 A1	20-05-2004	US 2007122101 A1	31-05-2007